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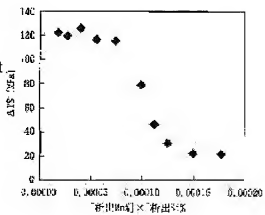
(54) COLD ROLLED STEEL SHEET AND PLATED STEEL SHEET CAPABLE OF INCREASING STRENGTH BY HEAT TREATMENT AFTER FORMING AND METHOD FOR PRODUCING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a cold rolled steel sheet easy to be processed before a heat treatment, because of its low strength and capable of effectively increasing the deformation strength and rigidity of members or parts thereof by the heat treatment at a relatively low temperature in a short time after the forming.



SOLUTION: The steel sheet has a composition containing, by mass, ≤0.15% C, 0.005 to 1.0% Si, 0.01 to 3.0% Mn, 0.005 to 0.02% Al, 0.006 to 0.020% N and 0.002 to 0.10% P also in a range satisfying N(%)/Al(%)≥ 0.3, and the balance Fe with inevitable impurities. In the steel, the product of the precipitated Mn% and the precipitated Si% is ≤0.00010, and solid solution N is contained in ≥0.0015%. The steel sheet further has a steel structure consisting of ferrite or essentially consisting of ferrite.

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]With mass percentage, C:0.15% or less, Si:0.005 - 1.0 %, Mn: 0.01-3.0 %, aluminum: They are N(%) / aluminum (%) about 0.005 to 0.02%, and N:0.006 - 0.020 %, and P:0.002 to 0.10%. It contains in the range with which it is satisfied of >=0.3, The remainder becomes the presentation of Fe and inevitable impurities, and, moreover, a product of deposit Mn% in steel and deposit Si%. It is 0.00010 or less, And cold rolled sheet steel excellent in intensity rise ability by heat treatment after shaping which contains the solid solvation N 0.0015% or more, and is characterized by a steel organization being an organization of a ferrite or a ferrite subject further.
[Claim 2]Cold rolled sheet steel excellent in intensity rise ability by heat treatment after shaping characterized by the following.
A kind or two sorts or more which steel is mass percentage and chose from among Cr and/or Mo:0.05-2.0 %, nickel:0.1 - 1.5 %, and Cu:0.1 - 1.5 % further in claim 1
Complex tissue where a steel organization furthermore contains martensite 3 to 40% with a volume fraction as the 2nd phase with a ferrite subject.

[Claim 3]Cold rolled sheet steel excellent in intensity rise ability by heat treatment after shaping in which steel is characterized by becoming the presentation containing one sort which is mass percentage and was further chosen from among Nb, Ti, and V, or below two or more sort sum total:0.3 % in claim 1 or 2.
[Claim 4]Cold rolled sheet steel which was excellent in intensity rise ability by heat treatment after shaping by which it is characterized in steel becoming the presentation which is mass percentage and contains further B:0.0003 to 0.0015% in claim 3.
[Claim 5]A plating steel plate which was excellent in the surface of the cold rolled sheet steel according to any one of claims 1 to 4 at intensity rise ability by heat treatment after shaping -ed

**(ing) an electroplating layer or a hot-dipping layer.
[Claim 6]With mass percentage, C:0.15% or less, Si:0.005 - 1.0 %, Mn: 0.01-3.0 %, aluminum: They are N(%) / aluminum (%) about 0.005 to 0.02%, and N:0.006 - 0.020 %, and P:0.002 to 0.10%. Steel slab which becomes the presentation contained in the range with which it is satisfied of >=0.3 is hot-rolled, Subsequently, it faces rolling round after hot-rolling and is a product of content of Mn and Si. [Mn%] x[Si%] In being 1.0 or less, it considers it as rolling-up temperature <=700 **, and it is one side. [Mn%] x[Si%] When larger than 1.0, it is rolling-up temperature <= 300+. 400/ [Mn%] x[Si%] After carrying out and cold-rolling after pickling subsequently, it describes above in a recrystallizing annealing process. [Mn%] x[Si%] It is annealing temperature when it is 1.0 or less. It is considered as 650 - 950 **, and is one side. [Mn%] x[Si%] are a following formula and 950-300/, when larger than 1.0. [Mn%] x[Si%] A manufacturing method of cold rolled sheet steel excellent in intensity rise ability by heat treatment after shaping annealing at temperature with which it is satisfied of <= annealing temperature (**) <= 950.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention A construction member, a machinery structural component, the structural component of a car, etc., It applies to the intensity on structure, especially the part by which intensity and/or rigidity are needed after shaping, and is a suitable steel plate, It is related with the manufacturing method of cold rolled sheet steel excellent in the intensity rise ability by heat treatment suitable as a stock steel sheet of the Plastic solid in which heat treatment is made after processing shaping especially by a press etc. after shaping, a plating steel plate, and cold rolled sheet steel.
[0002]
[Description of the Prior Art]there is a method of giving paint baking at less than 200 ** as a method of making press forming easy to carry out by elasticity, and making it harden after press forming and raising part intensity before press forming when manufacturing the press-forming object of steel sheets -- ** -- BH steel plate was developed as a steel plate [like] for paint baking.
[0003]For example, to JP,55-141526,A or JP,55-141555,A. According to C in steel, N, and Al content, add Nb, and restrict Nb/(dissolution C+ dissolution N) in a specific range by an atomic ratio, and. By controlling the cooling rate after annealing, the way the method of adjusting the dissolution C and the dissolution N in a steel plate raises baking hardenability by compound addition of Ti and Nb to JP,61-45689,B again is indicated. However, since a steel plate which was described above is thinking deep drawability as important, the intensity of a stock steel sheet is low and is not necessarily enough as a structural material. The method of W, Cr, and Mo being independent or therefore raising baking hardenability to carry out compound addition is indicated by steel at JP,5-25549,A.
[0004]However, the rise of the intensity by printing hardening only raises only the yield strength

of material using the dissolution C and the dissolution N which are included in a steel plate, and does not raise tensile strength (tensile strength). For this reason, about the effect which heightens the stress (henceforth the deformation strength characteristic) which has only an effect which heightens the modification start stress of a member or parts, and modification takes over the modification whole region from the modification start of a member or parts to the end of modification, it is not necessarily enough.

[0005]On the other hand, curing methods other than paint baking of a press-forming object include the method of performing nitriding treatment after press forming. For example, to JP,2-80539,A. The way the method of making nitridation elements, such as Cr, aluminum, and V, contain in steel so that intensity may increase by nitriding treatment carries out precipitation hardening of the Cu to JP,3-122255,A using the heat of nitriding treatment, and raises the hardness of a member again etc. are indicated. However, cooking temperature by these methods. More than 450 **, since it was high, when the usual galvanized steel sheet which aimed at corrosion-resistant improvement was used, the plating layer transpired and there was a fault that a corrosion-resistant good thing was not obtained.

[0006]In addition, the alloying hot-dip zinc-coated carbon steel sheet with which tensile strength rises, for example to JP,10-310847,A in the heat-treatment-temperature region of 200 - 450 ** in more than 60 MPa is indicated as cold rolled sheet steel in which tensile strength rises after shaping. This steel plate is mass percentage and contains Mn:0.01 - 3.0 % C:0.01 to 0.08%, And 0.05-3.0 % content of one sort of W, Cr, and Mo or two sorts or more is done in total, It becomes the presentation which contains one sort of Ti:0.005 - 0.1 %, Nb:0.005 - 0.1 %, and V:0.005 - 0.1 %, or two sorts or more if needed, and the microstructure of steel consists of a ferrite or a ferrite subject. However, since this art is a thing which makes detailed carbide form in a steel plate by heat treatment after shaping, and proliferates a rearrangement effectively to distortion given at the time of a press and to which a distortion amount is made to increase, It needed to heat-treat in the temperature requirement of 200 - 450 **, and there was a difficulty that the heat treatment temperature needed rather than a general printing curing treatment temperature is high. The paint baking temperature usually carried out with the automotive manufacturing line is before and after 170 **, and the heat treatment condition which amounts also to 450 ** is accompanied by difficulty to operation. For this reason, development of the cold rolled sheet steel which has the hardenability more than 60 MPa at low temperature more was desired.

[0007]

[Problem(s) to be Solved by the Invention]This invention responds in favor of the above-mentioned request, and an intensity level before processing shaping. It is easy to carry out processing shaping of press forming etc. with comparatively elastic high-strength steel by 340 - 700 MPa class, By the short time heat treatment in aiming at intensity rise comparison-after

fabricating operations, such as press forming, low temperature. It aims at proposing cold rolled sheet steel and a plating steel plate excellent in the intensity rise ability by heat treatment after shaping which raises tensile strength and hardness effectively and can improve the deformation strength characteristic and rigidity of a member or parts with the advantageous manufacturing method of cold rolled sheet steel.

[0008]

[Means for Solving the Problem]Now, as for artificers, heat treatment temperature after shaping A means which can increase tensile strength even when processing is added in a low temperature region of 120 - 200 **, When especially distortion of not less than 5% is added, as a result of repeating research wholeheartedly about a means as for which more than 60 MPa can increase tensile strength of cold rolled sheet steel, knowledge expressed below was acquired.

(1) In order to raise tensile strength after heat treatment, it is necessary to introduce a new rearrangement with shaping. It is necessary for a rearrangement introduced by ****** not to move, even if it reaches at an upper yield point by an interaction with a rearrangement, a penetration type element, or a sludge introduced by shaping.

(2) In order to obtain the above-mentioned interaction by making carbide, such as W, Cr, Mo, Ti, Nb, and aluminum, a nitride, or carbon nitride form, it is the heat treatment temperature after shaping. It is necessary to raise to not less than 200 **. Therefore, it is advantageous when reducing heat treatment temperature after positive practical use of a penetration type element fabricating.

(3) Even if an interaction with a rearrangement introduced by shaping is larger than the dissolution C among penetration type elements even if a direction of the dissolution N lowers heat treatment temperature after shaping, and it reaches at an upper yield point, it is hard to move a rearrangement introduced by ******.

(4) It becomes important especially to control nitridation by an interaction of the dissolution N and a rearrangement, when raising tensile strength by heat treatment after shaping. Mn and Si which are added for the purpose of solid solution strengthening of a steel plate, transformation organization strengthening, etc. have great influence on the dissolution N of cold rolled sheet steel.

That is, in order to obtain sufficient intensity rise ability and to secure the dissolution N, it was studied that it is important to store a product of deposit Mn% of cold rolled sheet steel and deposit Si% in a predetermined range. This invention is based on the above-mentioned knowledge.

[0009]That is, the gist composition of this invention is as follows.

With mass percentage, 1. C:0.15% or less, Si:0.005 - 1.0 %, Mn: 0.01-3.0 %, aluminum: They are N(%) / aluminum (%) about 0.005 to 0.02%, and N:0.006 - 0.020 %, and P:0.002 to 0.10%.

It contains in the range with which it is satisfied of >=0.3, The remainder becomes the presentation of Fe and inevitable impurities, and, moreover, a product of deposit Mn% in steel and deposit Si%. It is 0.00010 or less, And cold rolled sheet steel excellent in intensity rise ability by heat treatment after shaping which contains the solid solvation N 0.0015% or more, and is characterized by a steel organization being an organization of a ferrite or a ferrite subject further.

[0010]In the above 1, steel is mass percentage and further 2. Cr and/or Mo:0.05-2.0 %, Contain a kind chosen from among nickel:0.1 - 1.5 % and Cu:0.1 - 1.5 %, or two sorts or more, and a steel organization further with a ferrite subject. Cold rolled sheet steel excellent in intensity rise ability by heat treatment after shaping being the complex tissue which contains martensite 3 to 40% with a volume fraction as the 2nd phase.

[0011]3. Cold rolled sheet steel excellent in intensity rise ability by heat treatment after shaping in which steel is characterized by becoming presentation containing one sort which is mass percentage and was further chosen from among Nb, Ti, and V, or below two or more sort sum total:0.3 % in the above 1 or 2.

[0012]4. Cold rolled sheet steel which was excellent in intensity rise ability by heat treatment after shaping by which it is characterized in steel becoming presentation which is mass percentage and contains further B:0.0003 to 0.0015% in the above 3.

[0013]5. Plating steel plate which was excellent in the surface of cold rolled sheet steel given in either of the above 1-4 at intensity rise ability by heat treatment after shaping -ed **(ing) electroplating layer or hot-dipping layer.

[0014]With mass percentage, 6. C:0.15% or less, Si:0.005 - 1.0 %, Mn: 0.01-3.0%, aluminum: They are N(%) / aluminum (%) about 0.005 to 0.02%, and N:0.006 - 0.020 %, and P:0.002 to 0.10%. Hot-roll steel slab which becomes the presentation contained in the range with which it is satisfied of >=0.3, and it is faced rolling round after hot-rolling subsequently, A product of content of Mn and Si [Mn%] x[Si%] In being 1.0 or less, it considers it as rolling-up temperature <=700 **, and it is one side. [Mn%] x[Si%] When larger than 1.0, it is rolling-up temperature <= 300+400/. [Mn%] x[Si%] After carrying out and cold-rolling after pickling subsequently, it describes above in a recrystallizing annealing process. [Mn%] x[Si%] It is annealing temperature when it is 1.0 or less. It is considered as 650 - 950 **, and is one side. [Mn%] x [Si%] are a following formula and 950-300/, when larger than 1.0. [Mn%] x[Si%] A manufacturing method of cold rolled sheet steel excellent in intensity rise ability by heat treatment after shaping annealing at temperature with which it is satisfied of <= annealing temperature (**) <= 950.

[0015]

[Embodiment of the Invention]First, the research result which the foundation of this invention became is explained. After carrying out uniform heating of the sheet bar which becomes the

component composition shown in Table 1 to 1250 **, finishing temperature 3 path rolling was performed so that it might become 920 **, it quenched promptly after the end of rolling, and coil rolling-up temperature was changed and was held for 1 hour. Subsequently, recrystallizing annealing for 40 seconds was given at various temperature of 700 - 800 ** after performing rolling reduction:75% of cold rolling to the hot-rolling board of the obtained 4-mm thickness, and rolling reduction:1% of skin pass rolling was performed further.

[0016]

[Table 1]

鋼記号	成分組成 (mass%)								(Mn%)×[S1%]
	C	Mn	Si	P	S	Al	N	N/Al	
A	0.031	1.71	0.007	0.094	0.005	0.014	0.013	0.93	0.21
B	0.033	1.77	0.370	0.095	0.005	0.012	0.014	1.17	0.35
C	0.033	1.79	0.620	0.008	0.008	0.012	0.014	1.17	1.11
D	0.031	1.72	0.580	0.007	0.003	0.012	0.014	1.17	1.59
E	0.032	1.75	1.330	0.004	0.003	0.014	0.013	0.93	2.37

[0017]The JIS No. 5 test piece for tensile test was extracted, and tensile strength (TS_0) was measured from the cold rolled sheet steel obtained in this way using the usual tension tester on the conditions of $^{-1}$ for rate of strain:0.02 s. 5% of tensile strain are given to these cold rolled sheet steel -- after performing 170 ** and heat treatment for 20 minutes (an equivalent for paint baking processing), the test piece for tensile test was extracted, the same tensile test was performed, and it asked for tensile strength (TS_1). Intensity rise cost deltaTS (= TS_1-TS_0) by heat treatment after shaping is calculated, [Deposit Mn%] It reaches. [Deposit Si%] The result investigated about the relation is shown in drawing 1. As having been shown in drawing 1, [Deposit Mn%] xThe value of [deposit Si%]. When it was 0.00010 or less, it became clear that deltaTS became more than 60 MPa. When [all / when] deltaTS became more than 60 MPa, the amount of dissolution N beyond 0.0015mass% was secured.

[0018]Next, the constituent features and an operation of this invention are explained. First, the reason which limited the component composition of the steel plate to the aforementioned range in this invention is explained. % display of the component composition shown below is "mass %."

C:0.15%or less C is an element to which the intensity of steel is made to increase, and it is preferred to add 0.01% or more from a viewpoint of intensity reservation. On the other hand, since weldability would fall if contained exceeding 0.15%, it could be 0.15% or less. When it gives priority to the deep drawability of a steel plate, C comes out in small quantities as much as possible, and a certain direction is advantageous to press-forming nature. Since remelting

advances in the cold-rolled process after hot-rolling since the solid-solution limit of C to a ferrite phase is quite lower than N, and the dissolution C in a crystal grain increases, it is easy to reduce natural-aging-proof nature. Therefore, as for the amount of C, when thinking natural-aging-proof nature as important, it is desirable to consider it as 0.01% or less. As for a minimum, since reducing C too much, on the other hand, causes increase of steel-manufacture cost, it is desirable to consider it as about 0.0005%.

[0019]Although it is a useful ingredient where Si:0.005 - 1.0 %Si controls the fall of elongation and which raises intensity, Content. If it does not fill to 0.005%, it is deficient in the addition effect, and it is one side. Since a surface disposition not only gets worse, but a ductile fall will be caused if it exceeds 1.0%, it is Si. It limited to the range of 0.005 - 1.0 %. It is more desirable. It is 0.005 to 0.75% of range. Si and a Mn content are cold rolled sheet steel. [Deposit Mn%] It reaches. In order to affect [deposit Si%], it is necessary to rationalize hot-rolling conditions and annealing conditions according to such content. This is for the nitride which uses Mn, Si, and N as the main ingredients to form, and to change the dissolution N.

[0020]Mn: Although it acts effectively as a strengthening ingredient of steel, content 0.01 - 3.0 %Mn Since not only aggravation of a surface disposition but a ductile fall will be caused if it exceeds 3.0% It limited to 3.0% or less. It is more desirable. It is 2.0% or less. On the other hand, although Mn has the operation which forms MnS and controls embrittlement by S, effect with content sufficient at less than 0.01% is not acquired. Mn needs to rationalize hot-rolling conditions and annealing conditions like Si according to content.

[0021]Although aluminum is added as a deoxidizer aluminum:0.005 to 0.02% for the improvement in the yield of a carbon nitride forming component, An addition. There is not effect sufficient at less than 0.005%, and since the amount of N to be added will increase in steel if it exceeds 0.02% on the other hand, yield hit of N at the time of steel manufacture becomes difficult.

[0022]N:0.006 - 0.020 %N Post forming intensity rise heat treatment ability sufficient at less than 0.006% is not obtained, but it is one side. Since a blow hole will occur at the time of steel manufacture and press-forming nature will fall if N is made to contain exceeding 0.020%, it is N. It limited to 0.006 to 0.02% of range. It is desirable. It is 0.008 to 0.019% of range.

[0023]N(%) / aluminum (%) N plays the important role which gives post forming intensity rise ability to a steel plate in this invention as mentioned above >=0.3. for that purpose, the ratio of N content to Al content -- it is necessary to make N(%) / aluminum (%) or more into 0.3 Because, in order to be stabilized and to make 0.0015% or more of dissolution N remain regardless of change of manufacturing conditions, As a result of reaching far and wide and examining N about combination with aluminum which is an element fixed powerfully, in order to be stabilized and to make dissolution N with a final product into 0.0015% or more, they are N (%) / aluminum (%). It is because it became clear that it needed to be referred to as >=0.3. Mn

and the product of a Si content [Mn%] xSince the amount of deposit N in a final product will increase if [Si%] increases, it is preferred to control manufacturing conditions according to Mn and a Si content as a steel composition.

[0024]Heat treatment temperature after N:0.0015% or more of dissolution shaping: In order to secure intensity rise ability sufficient in the temperature requirement of 120 - 200 **, it is 5% of prestrain, for example. 170 ** aging treatment after In order to secure deltaTS more than 60 MPa, 0.0015% or more of dissolution N is needed. Therefore, at this invention, the amount of N is the above. The dissolution N is made to contain in 0.0015% or more of range further in the range with which it is satisfied of 0.006 - 0.020 %.

[0025]Although P:0.002 to 0.10%P contributed effective in strengthening of steel as a solid-solution-strengthening ingredient, since phosphides, such as $_{X}$(FeNb) P, were formed and deep drawability fell when it added exceeding 0.10%, the amount of P was restricted to 0.10% or less. It is 0.08% or less preferably. On the other hand, P is in the present steel-manufacture stage. Since cost increases to consider it as less than 0.002%, a minimum is a minimum of the present impurity level. It could be 0.002%.

[0026][Deposit Mn%] x[Deposit Si%] It is important to reduce the amount of deposit Mn and the amount of deposit Si as much as possible in <= 0.00010 and this invention, It is a product of deposit Mn% and deposit Si% as shown in above-shown drawing 1. Since 0.0015% or more of dissolution N is secured by using 0.00010 or less and intensity rise cost deltaTS by heat treatment after shaping can be set to 60 or more MPa, at this invention, they are these products. [Deposit Mn%] x[Deposit Si%] It limited to 0.00010 or less.

[0027]As mentioned above, although the essential ingredient was explained, in addition to this, the following elements can be made to contain suitably in this invention.

It is effective in each of Cr(s) and/or Mo:0.05 - 2.0 %Cr(s), and Mo raising the hardenability of steel, and promoting generation of a martensitic phase. However, such content is deficient in the addition effect at less than 0.05%, and it is one side. If it exceeds 2.0%, degradation of a moldability, plating nature, and spot welding nature will be caused. Therefore, these are made to contain in the range of 0.05 - 2.0 % in the case of which [of single use or concomitant use].

[0028]nickel: 0.1 - 1.5, Cu:0.1 - 1.5 %nickel and Cu are elements to which the intensity of steel is made to increase by solid solution strengthening, and austenite is stabilized by the cooling process after annealing, and there is an effect which make easy to form 2 phase organizations and a low-temperature transformation phase. ** -- an effect [like] -- nickel and Cu -- content since a moldability, plating nature, and weldability will be reduced if it adds exceeding 1.5 % although it accepts at 0.1% or more -- nickel and Cu -- respectively -- It limited to the range of 0.1 - 1.5 %. And martensite can be made to generate effectively as the 2nd phase by making any one sort or two sorts or more in the above-mentioned Cr and/or Mo, nickel, and Cu

contain.

[0029]One sort chosen from among Nb, Ti, and V or below two or more sort sum total:0.3 % Nb, Ti, and V is a carbon nitride formation element, and it has an effect to which minuteness making of a hot-rolling organization and the cold-rolled recrystallizing annealing organization is carried out, respectively. Since the amount of carbon nitride formation will increase and this effect will cause the fall of the tensile strength ascending amount by heat treatment after shaping if 0.3 % is exceeded although it is accepted above 0.001 %, these elements are in total. It limited to 0.3% or less of range.

[0030]B:0.0003 to 0.0015%B has the work which contributes to the minuteness making of a hot-rolling organization and cold-rolled recrystallized structure, and improves fabricating-proof brittleness by carrying out compound addition with Nb, Ti, and V. However, since BN precipitation amount will increase and it will interfere with solution-ization by a slab heating stage if minuteness making effect with the amount sufficient at less than 0.0003% of B is not acquired but it exceeds 0.0015% on the other hand, B is made to contain in 0.0003 to 0.0015% of range. It is 0.0007 to 0.0012% of range especially preferably.

[0031]S:0.01% or less, in addition to this, as for mixing of S, since the amount of inclusion will increase and a ductile fall will be caused if S contains so much especially among an impurity, avoiding as much as possible is desirable, but if it is to 0.01%, it approves.

[0032]In the above-mentioned component composition range, when it adjusts to the component composition of claim 1, a steel organization turns into an organization of a ferrite or a ferrite subject. As phases other than a ferrite, perlite, bainite, retained austenite, martensite, etc. are mentioned here. A ferrite subject's organization means here the organization which contains a ferrite phase not less than 60% with a volume fraction. The ferrite as used in the field of this invention shall contain the BEINI tick ferrite and reed cura ferrite which do not contain not only the ferrite (polygonal ferrite) of the usual meaning but carbide.

[0033]Like claim 2, in steel, further, if Cr, Mo, nickel, and Cu are added, Although it is effective in a ferrite being made into a subject, being able to make martensite generate not less than (more than 3 vol%) 3% by a volume rate as the 2nd phase, dividing this martensite at more than 3 vol%, and raising ductility to fitness, 40 As for the generated amount, since sufficient ductility in which intensity becomes high too much is not securable if vol% is exceeded, when making martensite generate as the 2nd phase, it is preferred to use less than 40 vol%. A little low-temperature transformation phases (bainite) may generate in this case. By using such transformation organization steel, ductility can be improved substantially.

[0034]Next, the manufacturing method according to this invention is explained. The steel adjusted to the above-mentioned suitable component composition is ingoted by the usually publicly known ingot methods, such as a converter, is solidified by the ingot making method or a continuous casting process, and let it be steel stock. Continuous casting slab is as [casting],

may be directly delivered to a hot-rolling process, is once reheated after cooling, and may be supplied to a hot-rolling process. Let these steel stock be hot-rolling boards with hot-rolling after carrying out soak, heating and. Although this invention does not prescribe the cooking temperature in particular of hot-rolling, in order to solution-ize N, cooking temperature is good to consider it as not less than 1150 **. For much more improvement in solution-izing, it is preferred to consider it as not less than 1200 **. However, if cooking temperature exceeds 1300 **, the improvement effect of solution-izing will be saturated and will cause the fall of the processability accompanying big-and-rough-izing of a crystal grain conversely.

[0035]As for the bottom rate of total pressure of hot-rolling, it is preferred to consider it as not less than 70%. It is because grain refining of a hot-rolling board becomes insufficient at less than 70%. Although any of gamma region more than Ar_3 transformation point or alpha region below Ar_3 transformation point may be sufficient as hot-rolling finishing temperature, it is a temperature requirement of 960 - 650 ** especially preferably. Because, hot-rolling finishing temperature If it exceeds 960 **, the crystal grain of a hot-rolling board will become big and rough, the processability after cold-rolling and annealing falls, and it is one side. It is because deformation resistance increases, so increase of hot-rolling load is caused and rolling becomes difficult at less than 650 **.

[0036]After the end of hot finish rolling has it, when cooling promptly prevents grain growth and it controls the deposit of Mn called the deposit and $MnSiN_2$, or MnSiN of AlN in a cooling process, and Si, and it can attain minuteness making of a crystal grain in this way.

[advantageous]

[0037]Subsequently, a hot-rolling board is rolled round by the coiled form. Although the rolling-up temperature of a hot-rolling board is as advantageous to big-and-rough-izing of carbide as an elevated temperature, if 800 ** is exceeded, the scale formed in a hot-rolling sheet surface becomes thick, the nitridation will advance and the load of descaling work not only increases, but it will cause change of the amount of dissolution N of the direction of a coil length hand. Rolling-up temperature. In less than 200 **, rolling-up work becomes difficult. Therefore, rolling-up temperature from these viewpoints It is preferred to consider it as not less than 200 ** and 800 ** or less.

[0038]After carrying out uniform heating of the sheet bar which becomes the component composition shown in the above-shown table 1 at 1270 **, finishing temperature 3 path rolling is performed so that it may become 920 **, and it quenches promptly after the end of hot-rolling, and is coil rolling-up temperature. It was made to change with 750, 610, 480, and 350 **, and held for 1 hour. After performing rolling reduction:75% of cold rolling to the hot-rolling board of the obtained 4-mm thickness, recrystallizing annealing for 40 seconds was given to it by 820 **, and rolling reduction:1% of skin pass rolling was further performed to it. The JIS No.

5 test piece for tensile test was extracted, and tensile strength (TS_0) was measured from the cold rolled sheet steel obtained in this way using the usual tension tester on the conditions of $^{-1}$ for rate of strain:0.02 s. 5% of tensile strain are given to these cold rolled sheet steel -- after performing 170 ** and heat treatment for 20 minutes (an equivalent for paint baking processing), the test piece for tensile test was extracted, the same tensile test was performed, and it asked for tensile strength (TS_1).

[0039]Intensity rise cost deltaTS (= TS_1-TS_0) by heat treatment after shaping is calculated, [Mn%] It reaches. [Si%] The result investigated about the relation is shown in drawing 2. The numerical value in O in a figure is deltaTS. clear from the figure -- as -- the product of the content of Mn and Si -- namely [Mn%] x[Si%] In being 1.0 or less, it considers it as CT<=700 **, and it is one side. [Mn%] x[Si%] When larger than 1.0, it is CT<= 300+. 400/ [Mn%] x[Si%] By carrying out, it was able to be stabilized, 0.0015% or more of the amount of dissolution N could be secured, and deltaTS>=60 MPa was able to be attained.

[0040]Subsequently, cold rolling is performed after carrying out pickling of the hot-rolling board. Rolling reduction in this cold rolling: It is preferred to consider it as 60 to 95%. It is because rolling load will increase if cold-rolled rolling reduction has the small stored energy at the time of recrystallization and exceeds 95% on the other hand in less than 60%.

[0041]Subsequently to recrystallizing annealing, the cold rolled sheet steel in which it was cold-rolled is offered. Recrystallizing annealing conditions It is preferred to consider it as not less than 650 ** and 5 seconds or more. Because, annealing temperature and time are each. It is because recrystallization is not completed, therefore processability falls in less than 650 ** and less than 5 seconds. In order to raise processability more It is desirable to consider it as 5 seconds or more above 800 **. Maximum of annealing temperature It is preferred to consider it as 950 **. Because, annealing temperature It is because remelting of carbide will advance, the dissolution C will increase too much, if it exceeds 950 **, so resistance to aging deteriorates. As for recrystallizing annealing, it is preferred to carry out with a continuous annealing line or a continuation plating line. The main types of gas of an annealing atmosphere are H_2 and N_2, and, as for the mixed gas of H_2 and N_2, it is preferred to consider it as N_2 gas containing 3 to 9% of H_2.

[0042]As for cooling after the recrystallizing annealing in continuous annealing, it is preferred to cool in s in not less than at least 10 ** /after annealing by this invention from the minuteness making of an organization and a viewpoint of reservation of the amount of dissolution N. It is not less than 20 **/s more preferably. A cooling rate. Since faults, such as a fall of the homogeneity of the construction material in the cross direction of a steel plate, will occur if s is exceeded in 300 ** /, it is a cooling rate. It is preferred to be referred to as s in 300 ** /or less.

[0043]After carrying out uniform heating of the sheet bar of steel A-E shown in the above-shown table 1 to 1270 **, finishing temperature 3 path rolling is performed so that it may become 920 **, and it quenches promptly after the end of rolling, and is coil rolling-up temperature. It was considered as 450 ** and held for 1 hour. After performing rolling reduction:75% of cold rolling for the hot-rolling board of the obtained 4-mm thickness, recrystallizing annealing for 40 seconds was given at various temperature, and rolling reduction:1% of skin pass rolling was performed further. The JIS No. 5 test piece for tensile test was extracted, and tensile strength (TS_0) was measured from the cold rolled sheet steel obtained in this way using the usual tension tester on the conditions of $^{-1}$ for rate of strain:0.02 s. 5% of tensile strain are given to these cold rolled sheet steel -- after performing 170 ** and heat treatment for 20 minutes (an equivalent for paint baking processing), the test piece for tensile test was extracted, the same tensile test was performed, and it asked for tensile strength (TS_1).

[0044]It asks for the intensity rise cost ($deltaTS=TS_1-TS_0$) by heat treatment after shaping, [Mn%] It reaches. [Si%] The result investigated about the relation is shown in drawing 3. The number in O in a figure is deltaTS. clear from the figure -- as [Mn%] xWhen [Si%] is 1.0 less or equal, annealing temperature deltaTS>=60 MPa can be attained in the range of 650 - 950 **. On the other hand, [Mn%] x[Si%] When larger than 1.0, it is 950-300/. [Mn%] x[Si%] deltaTS>=60 MPa was able to be attained in the range of <= annealing temperature (**) <=950.

[0045]10% or less of temper rolling may be performed to a steel plate after the above-mentioned recrystallizing annealing for shape straightening and surface roughness adjustment. Even if it performs electroplating or hot dipping to the surface of the cold rolled sheet steel produced by performing it above in this invention, it is satisfactory in any way. TS also with these plating steel plates comparable as cold rolled sheet steel, the amount of BHs, and the amount of deltaTS are shown. moreover -- as the kind of plating -- any, such as electrogalvanizing, hot dip zincing, alloying hot dip zincing, electric tinning, electric chrome plating, and electric nickel plating, -- although -- it suits advantageously.

[0046]When performing hot-dip-zincing processing to the cold rolled sheet steel which passed through recrystallizing annealing and -ed **(ing) a hot-dip-zincing layer to a steel sheet surface, board temperature plating processing usually like the conditions performed with a hot-dip-zincing line It is preferred to give hot dip zincing in the temperature requirement of 450 - 550 **. As for a zinc bath, it is preferred to consider it as Zn bath which contains aluminum 0.10 to 0.15%. It cannot be overemphasized after this plating processing that wiping for metsuke amount adjustment may be performed if needed. It is also possible to carry out plate leaping of the cold rolled sheet steel which passed through the recrystallizing annealing

process to a continuation plating annealing line, and to plate it after annealing again. However, annealing temperature was mentioned above also in this case. [Mn%] **It is necessary to satisfy the conditions regulated by [Si%]. It is preferred the annealing back and to cool even 550 ** at speed (not less than 10 **/[s and] and 300 **/less than s).

[0047]Alloying treatment which alloys a plating layer may be performed after the above-mentioned hot-dip-zincing processing. Cooking temperature in alloying treatment It is preferred to consider it as 450 ** - Ac_1 transformation point grade. Because, cooking temperature It is because alloying of a plating layer will advance too much and a plating layer will embrittle, if advance of alloying will be slow and will cause the fall of productivity, if less than 450 **, and Ac_1 transformation point is exceeded on the other hand. in addition -- although a steel plate is cooled after plating processing -- the -- in process About the temperature region up to 300 **, it is preferred to cool at not less than 5 **/s in speed. the steel plate (a dull finishing steel plate.) which performed temper rolling for improvement in processability, or the appearance after processing after considering it as the above-mentioned alloying hot-dip zinc-coated carbon steel sheet etc. About steel plates for which the surface treatment adopted as steel sheets was usually performed, such as a steel plate in which the specific shape pattern was formed on a bright art metal and the surface, and a steel plate which has oil film layers, such as slushing oil and a lubricating oil, on the surface further, each can apply this invention and the effect can fully be enjoyed.

[0048]Then, press working of sheet metal, such as processing shaping, for example, spinning etc., is performed. It faces performing this press working of sheet metal, and it is necessary to give the rearrangement of a suitable quantity for a steel plate. In order to raise intensity after heat treatment, it is required for the part for which intensity and hardness are needed for at least 2% of plastic equivalent strain to give. When there are too few distortion amounts, even if it performs post forming heat treatment, sufficient intensity rise is not revealed. It is preferred to give not less than 5% of plastic equivalent strain suitably, and deltaTS>=60 MPa can be secured in this case.

[0049]Heat treatment at low temperature is performed after press forming. Under the present circumstances, heat treatment temperature is conventionally performed by paint baking processing. A 120 - 200 ** grade may be sufficient. Heat treatment temperature. At less than 120 **, when a plastic equivalent strain has low post forming intensity rise heat treatment ability, it is not fully obtained. On the other hand, although post forming intensity rise heat treatment ability satisfies the heat-treatment over 200 **, exceptional heating apparatus may be needed. As a heating method, methods, such as hot wind heating, infrared furnace heating, hot bath heat treatment, energizing heating, and high frequency induction heating, can be applied, and it is not specified in particular. The case where only the portion which intensity wants to rise is heated selectively may be sufficient. In addition Heat treatment over 250 ** has

the concern which spoils a surface disposition.

[0050]

[Example]Steel slab which becomes the component composition shown in the example 1 table 2 was used as the hot-rolling board on the hot-rolling conditions shown in Table 3. Subsequently, after cold-rolling to these hot-rolling boards and considering it as a cold-rolled board, recrystallizing annealing was given in the continuous annealing line, and temper rolling of rolling reduction:1.0 % was performed further. The result investigated about the organization of the product sheet obtained in this way, a mechanical property, and the characteristic after ******-paint baking is shown in Table 4.

[0051]Tractive characteristics extracted and carried out the JIS No. 5 specimen from the product sheet. the amount of dissolution N -- and [Deposit Mn%] [Deposit Si%] was asked as follows. As for the amount of dissolution N, the amount of deposit Mn, and the amount of deposit Si, it is effective to ask with the electrolytic extraction analysis method which used chronoamperometry, and methods of dissolving the ferrite used for extraction analysis include an acid hydrolysis method, the halogen process, and an electrolytic decomposition process. In this, without making very unstable sludges, such as carbide and a nitride, disassemble, it is stabilized, and an electrolytic decomposition process can be extracted and can dissolve only a ferrite. In this invention, Mn in the electrolytic extraction thing for which it asked by the above-mentioned method, and the amount of Si are measured, [Deposit Mn%] **[Deposit Si%] It carried out. The amount of dissolution N considered N in the electrolytic extraction thing which carried out electrolytic extraction as mentioned above as the deposit N, and deducted and calculated the amount of deposit N from the total amount of N in steel.

[0052]It asked for the other characteristics as follows.

- A JIS No. 5 specimen is extracted from strain-aging hardening characteristic each product sheet to a rolling direction, 5% of ********** is given as ******, and it is an occasion. After heat-treating an equivalent for 170 ** and the paint baking processing for 20 minutes, Strain rate: The tensile test was carried out on condition of $^{-1}$ for 0.02 s, ****** was performed, tensile strength TS_{BH} after performing paint baking processing further was calculated, and deltaTS=TS_{BH}-TS was calculated. TS is the tensile strength of a product sheet.

- Organization each piece of a steel plate blank test was extracted, and about the section (C section) which intersects perpendicularly with a rolling direction, fine ****** was picturized using the optical microscope or the scanning electron microscope, and it asked for the kind of organization, and the organization molar fraction of the ferrite using the image analyzing device.

[0053]- Extract an impact test specimen from shock resistant characteristic each product sheet to a rolling direction, and it is based on the high-speed tensile test method indicated to

"Journa1 ofSociety of Materials Science Japan. 10. (1998) P.1058", Rate of strain: The high-speed tensile test was carried out by $^{-1}$ for 2000 s, and the stress-strain curve was measured. Using the obtained stress-strain curve, it was distorted, it integrated with stress in :0-30% of the range, and asked for absorbed energy E. 5% of **** modification is given as ******, and it is an occasion. After performing paint baking equivalent heat treatment for 170** $_{and}$ 20 minutes, the same impact test was carried out, absorbed energy E_{BH} was calculated, and improvement cost E_{BH}/E of the shock resistant characteristic by ******-paint baking processing was evaluated.

[0054]

[Table 2]

鋼記号	成分組成 (mass%)									[Mn%]×[Si%]	備考
	C	Mn	Si	P	S	Al	N	N/Al	その他		
F	0.081	1.26	0.05	0.017	0.002	0.018	0.013	0.72		0.06	発明例
G	0.072	1.53	0.35	0.016	0.004	0.015	0.014	0.93		0.54	〃
H	0.080	2.00	0.55	0.015	0.005	0.013	0.015	1.15		1.10	〃
I	0.035	1.23	0.03	0.012	0.005	0.012	0.015	1.25	Mo：0.15	0.04	〃
J	0.050	1.71	0.41	0.016	0.004	0.010	0.016	1.60	Cr：0.50	0.70	〃
K	0.110	2.08	0.95	0.015	0.003	0.012	0.018	1.50		1.98	〃
L	0.070	1.50	0.95	0.012	0.002	0.015	0.016	1.07		1.43	〃
M	0.003	0.15	0.01	0.012	0.002	0.012	0.012	1.00		0.002	〃
N	0.002	1.49	0.52	0.049	0.005	0.011	0.013	1.18	Nb：0.014	0.77	〃
O	0.003	1.09	0.01	0.051	0.004	0.010	0.018	1.80	Nb：0.015, Ti：0.018	0.01	〃
P	0.002	1.00	0.73	0.080	0.005	0.013	0.019	1.46	V：0.02	0.73	〃
Q	0.004	1.53	0.81	0.005	0.004	0.010	0.015	1.50	Nb：0.016, B：0.0008	1.24	〃
R	0.075	1.35	1.25	0.017	0.003	0.012	0.016	1.33		1.69	比較例
S	0.001	3.50	0.05	0.019	0.002	0.015	0.015	1.00		0.18	〃

[0055]

[Table 3]

No.	鋼記号	[Mn%]×[Si%]	スラブ加熱温度 SRT (℃)	仕上げ圧延 出側温度 FDT (℃)	仕上げ圧延 熱延板板厚 (mm)	巻取り 巻取温度 (℃)	巻取り 巻取上限温度 (℃) *	冷間圧延 冷延圧下率 (%)	冷間圧延 冷延板板厚 (mm)	連続焼鈍 焼鈍温度 (℃)	連続焼鈍 保持時間 (s)	連続焼鈍 焼鈍下限温度 (℃)**	冷却速度 (℃/s)	備考
1	F	0.06	1230	840	4.5	680	700	70	1.4	800	36	650	32	発明例
2	G	0.54	1240	870	4.5	690	700	65	1.6	800	30	650	33	〃
3	H	1.10	1210	850	3.5	600	664	65	1.2	820	45	677	25	〃
4	〃	1.10	1210	870	2.3	600	664	65	1.2	650	21	677	33	比較例
5	〃	1.10	1210	850	2.5	695	664	65	1.2	780	25	677	27	〃
6	I	0.04	1230	840	2.5	580	700	62	1.0	720	34	650	47	発明例
7	J	0.70	1240	850	3.5	670	700	62	1.3	760	28	650	25	〃
8	K	1.98	1210	850	3.5	595	502	60	1.4	820	33	798	20	〃
9	L	1.43	1230	870	3.5	350	581	65	1.2	780	48	739	37	〃
10	M	0.002	1210	860	3.5	600	700	80	0.7	840	27	650	55	〃
11	N	0.77	1230	860	2.3	670	700	62	1.0	720	40	650	35	〃
12	O	0.01	1240	880	3.0	680	700	62	1.1	770	42	650	47	〃
13	P	0.73	1230	850	2.5	660	700	68	0.8	840	47	650	44	〃
14	Q	1.24	1240	890	3.0	550	623	60	1.2	760	34	708	37	〃
15	〃	1.24	1230	850	3.0	659	623	60	1.2	700	37	708	43	比較例
16	R	1.59	1200	880	4.5	600	537	70	1.4	790	38	772	52	〃
17	S	0.18	1210	870	4.0	750	700	70	1.2	645	26	650	27	〃

* 1式 MnおよびSi含有量による巻取り温度上限
〔Mn%〕×〔Si%〕≦1.0 の時、巻取温度上限≦700 ℃
〔Mn%〕×〔Si%〕＞1.0 の時、巻取温度上限＜300＋400／(〔Mn%〕×〔Si%〕)℃

** 2式 MnおよびSi含有量による焼鈍温度下限
〔Mn%〕×〔Si%〕≦1.0 の時、焼鈍温度下限≦650 ℃
〔Mn%〕×〔Si%〕＞1.0 の時、焼鈍温度下限＜950－300／(〔Mn%〕×〔Si%〕)℃

[0056]

[Table 4]

No.	鋼記号	[Mn%]×[Si%]	製品板特性 [析出Mn%]×[析出Si%]	固溶N量 (mass%)	YS (MPa)	TS (MPa)	El (%)	鋼品組織 フェライト体積率 (vol%)	鋼品組織 第2相種類*	予変形＋塗装焼付け後特性 YS (MPa)	予変形＋塗装焼付け後特性 TS (MPa)	予変形＋塗装焼付け後特性 ΔTS (MPa)	予変形＋塗装焼付け後特性 耐衝撃特性 (E-s/E)	備考
1	F	0.06	0.0002	0.0062	330	472	36	94	P	411	565	93	1.15	発明例
2	G	0.54	0.0005	0.0051	365	523	32	95	P	446	610	87	1.14	〃
3	H	1.10	0.0008	0.0072	466	621	26	85	B	549	735	114	1.12	〃
4	〃	1.10	0.0025	0.0063	469	625	26	84	B	524	668	43	0.92	比較例
5	〃	1.10	0.0023	0.0068	453	604	27	85	B	494	648	44	0.94	〃
6	I	0.04	0.0008	0.0055	294	452	39	96	M	383	546	94	1.16	発明例
7	J	0.70	0.0008	0.0079	379	532	28	94	M	484	727	95	1.17	〃
8	K	1.98	0.0007	0.0075	593	847	20	93	P	671	948	101	1.15	〃
9	L	1.50	0.0004	0.0076	494	708	30	92	R	570	821	115	1.14	〃
10	M	0.002	0.0005	0.0088	242	346	50	100	—	331	449	103	1.12	〃
11	N	0.77	0.0005	0.0046	330	471	37	100	—	409	558	87	1.18	〃
12	O	0.01	0.0004	0.0104	277	395	44	100	—	369	486	91	1.17	〃
13	P	0.73	0.0007	0.0097	355	507	34	100	—	436	608	101	1.18	〃
14	Q	1.24	0.0007	0.0074	317	452	38	76	B	400	565	112	1.18	〃
15	〃	1.24	0.0027	0.0067	317	452	38	78	B	378	489	36	0.92	比較例
16	R	1.59	0.0030	0.0095	445	595	35	91	R	486	640	45	0.93	〃
17	S	0.18	0.0018	0.0012	441	658	27	89	M＋B	481	716	58	0.96	〃

* 第2相種類 P：パーライト、B：ベイナイト、M：マルテンサイト、R：残留オーステナイト

[0057]The product sheet with which it is satisfied of the requirements for this invention all has the high rise of the tensile strength by post forming heat treatment compared with a comparative example so that clearly from Table 4.

[0058]Steel slab which becomes the component composition shown in the example 2 table 5 was used as the hot-rolling board on the hot-rolling conditions shown in Table 6. Subsequently, 840 ** and the recrystallizing annealing for 20 seconds after cold-rolling these hot-rolling boards with the rolling reduction shown in Table 6 were given. The temperature of these 840 ** is a temperature higher than the annealing temperature lower limit by which the steel type X, Y, and Z is regulated with Mn and a Si content. Subsequently, hot dip zincing or alloying hot dip zincing was given on the continuation plating annealing conditions which show the oxidizing zone of a steel sheet surface in Table 6 pickling or after removing mechanically. At this time, all alloying treatment temperature was carried out below Ac_1 transformation point. Then, rolling reduction: 0.8 to 1.2% of temper rolling was performed. The result investigated about the organization of the product sheet obtained in this way, a mechanical property, and the characteristic after ******-paint baking is shown in Table 7.

[0059]

[Table 5]

鋼記号	成分組成 (mass%)									[Mn%]×[Si%]
	C	Mn	Si	P	S	Al	N	N／Al	その他	
X	0.035	1.50	0.20	0.02	0.003	0.014	0.015	1.14	Mo：0.16	0.30
Y	0.071	1.80	0.60	0.02	0.002	0.015	0.017	1.13	—	1.08
Z	0.113	2.08	0.80	0.03	0.002	0.013	0.018	1.38	—	1.66

[0060]

[Table 6]

No.	鋼記号	スラブ加熱温度 SHT (℃)	仕上げ圧延 出側温度 FDT (℃)	仕上げ圧延 熱延板厚 (mm)	巻取り 巻取温度 (℃)	巻取上限温度 (℃)＊2	冷間圧延 冷延圧下率 (%)	冷延板厚 (mm)	連続めっき焼鈍 焼鈍温度 (℃)	焼鈍時間 (s)	焼鈍下降速度 (℃)##	550℃までの冷却速度 (℃/s)	めっき処理後の板温 (℃)	合金化処理温度 (℃)	合金化処理時間 (s)	200℃までの冷却速度 (℃/s)	調質圧延圧下率 (%)	備考
18	X	1190	880	3.5	520	709	65	1.2	820	20	650	15	500	—	—	25	1.0	発明例
19	〃	1200	870	〃	490	〃	〃	〃	800	25	〃	20	460	470	20	16	1.1	〃
20	〃	1260	900	〃	750	〃	〃	〃	780	35	〃	15	520	470	25	21	0.8	比較例
21	Y	1180	850	4.0	650	670	60	1.6	800	20	672	15	515	—	—	30	0.9	発明例
22	〃	1170	850	〃	500	〃	〃	〃	810	25	〃	25	490	475	25	15	1.0	〃
23	〃	1150	860	〃	500	〃	〃	〃	650	21	〃	30	480	475	25	19	1.0	比較例
24	Z	1220	880	3.5	500	541	55	1.6	790	30	768	25	500	—	—	25	0.9	発明例
25	〃	1250	850	〃	520	〃	〃	〃	820	25	〃	26	510	480	20	14	1.2	〃
26	〃	1180	850	〃	560	〃	〃	〃	700	40	〃	25	500	490	25	25	1.0	比較例

＊1式 Mnおよび[Si]含有量による巻取り温度上限
(Mn%)×[Si%]≦1.0 の時、巻取温度上限≦720 ℃
(Mn%)×[Si%]>1.0 の時、巻取温度上限<300+400/((Mn%)×(Si%))℃
＊＊2式 Mnおよび[Si]含有量による焼鈍温度下限
(Mn%)×[Si%]≦1.0 の時、焼鈍温度下限≦650 ℃
(Mn%)×[Si%]>1.0 の時、焼鈍温度下限<920−300/((Mn%)×(Si%))℃
— は合金化処理なし

[0061]

[Table 7]

No.	鋼記号	(Mn%)×(Si%)	製品板特性 (析出Mn%)×(析出Si%)	製品板特性 固溶N量 (mass%)	製品板特性 YS (MPa)	製品板特性 TS (MPa)	製品板特性 El (%)	製品組織 フェライト体積率 (vol%)	製品組織 第2相種類＊	予変形−塗装焼付け後特性 YS (MPa)	予変形−塗装焼付け後特性 TS (MPa)	予変形−塗装焼付け後特性 ΔTS (MPa)	予変形−塗装焼付け後特性 耐衝撃特性 (E_{WB}/E)	備考
18	X	0.30	0.00095	0.0078	282	455	39	95	M	407	530	75	1.15	発明例
19	〃	〃	0.00033	0.0079	261	453	41	96	M	410	534	81	1.12	〃
20	〃	〃	0.00015	0.0007	279	450	38	95	M	344	472	22	1.02	比較例
21	Y	1.08	0.00095	0.0075	418	615	26	94	B	553	700	85	1.15	発明例
22	〃	〃	0.00094	0.0079	411	605	25	93	B	541	697	92	1.16	〃
23	〃	〃	0.00320	0.0005	437	643	26	95	B	502	663	20	0.98	比較例
24	Z	1.96	0.00094	0.0075	578	825	20	93	P	711	903	78	1.17	発明例
25	〃	〃	0.00095	0.0081	571	815	19	92	P	710	898	83	1.19	〃
26	〃	〃	0.00350	0.0000	585	835	20	92	P	640	838	3	0.97	比較例

＊第2相種類 P：パーライト、B：ベイナイト、M：マルテンサイト、R：残留オーステナイト

[0062]Each plating steel plate with which it is satisfied of the requirements for this invention has the high rise of the tensile strength by post forming heat treatment like the case where cold rolled sheet steel examines, compared with a comparative example as shown in Table 7.

[0063]

[Effect of the Invention]In this way, according to this invention, maintaining the processability outstanding at the time of press forming, by press-forming-heat treatment, it is stabilized

industrially and plating steel plates, such as cold rolled sheet steel whose tensile strength improves substantially, and also an alloying hot-dip zinc-coated carbon steel sheet, can be manufactured.

[Translation done.]